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STUDIES IN INDIAN EMBIOPTERA. PART I—THE OLIGOTOMIDAE OF INDIA.

By A. P. KAPUR AND (MISS) M. B. KRIPALANI.
(*Zoological Survey of India, Indian Museum, Calcutta*).

Manuscript received 13th June, 1956.

(Read 5th December, 1956).

With 40 Text-figures.

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INTRODUCTION.

THE Embioptera comprise one of the most clearly defined, small and compact orders of insects. It is mainly tropicopolitan, being restricted for the most part to the tropics and subtropics but sometimes extending into warm temperate zones, using ships and similar transport as a means of dispersal.

The adults are dimorphic, the males being mostly winged and the females apterous and neoteinic. They usually live gregariously in silken tunnels constructed by themselves. The females exhibit parental care by remaining near the eggs and the young. Their mode of life is of considerable interest as it may be regarded as representing one of the earliest stages of development of social life among insects.

The Embioptera appear to be unorthodox in their feeding habits and their food may consist of almost anything of vegetable origin, preferably dead leaves, etc. Ross (1940), in referring to their food habits, states that "unlike many organisms they are perhaps able to seek their optimum environment free from the consideration of food supply as it is almost certain that a potential source is already present wherever they choose to live. This has probably been of the greatest importance in the survival of the order into modern time". Phylogenetically, also, the order is interesting because of its remarkable simplicity and uniformity of structure. Imms (1913) remarks as follows: "That they are an ancient group, and now long past the zenith of their prime is probable. In this respect they are worthy of comparison with *Peripatus* and *Anaspides* among Arthropods". When considering the systematic position of the order, Tillyard (1923), using wing venation and palaeontological

evidence, placed it near the Plecoptera. Others, like Snodgrass (1937), using the male genitalic characters, and Kershaw (1914), employing embryological evidence, believe it to belong to an Orthopteroid group. Mukerji (1927) suggests that the members of the order are the only surviving representatives of the Protorthoptera.

This interesting order is represented in India by the families Embiidae and Oligotomidae. The Embiidae has been recently revised by Ross (1950), who added four new species from the Indian area,¹ bringing the total to 11 species. The family Oligotomidae, as represented in this region by the genus *Oligotoma* Westwood, was last studied in detail by Davis (1940). He recorded a total of seven species, namely *O. saundersii* (Westwood), *O. humbertiana* (Saussure), *O. nigra* (Hagen), *O. greeniana* Enderlein, *O. michaeli* McLachlan, *O. ceylonica* Enderlein and *O. asymmetrica* Menon and George. Subsequently, Ross (1943) described one more species, *O. falcis* Ross, bringing the total number to eight. In this paper six further species from India and Ceylon are added. These are all in the collection of the Indian Museum (Zoological Survey of India, Calcutta). The present study also leads the authors to believe that *O. minuta* Mukerji (1935) is a good species and should be revived. *O. greeniana* Enderlein (1912), hitherto known only from Ceylon, is now recorded from India (Calcutta) for the first time. This brings the total number of known species of Oligotomidae from the region studied to 15. The material before us is extensive and several new distribution records are given of the species already known from India.

II. METHOD OF STUDY.

The material, which was mostly preserved in alcohol, was first carefully examined under a stereoscopic binocular and the body form, dimensions, colour and other characters noted. For further detailed study the specimens were treated with 10 per cent. KOH (cold) for varying lengths of time, from a few hours to a day, depending on their size and state of preservation, and, after the usual process of neutralisation and dehydration, they were cleared in clove oil and then studied in detail, when rough sketches were made of the different parts of the terminalia. For final sketches the specimens were mounted in Canada balsam. In the case of very light examples acid fuchsin stain was also employed.

The systematic treatment is based on the characters of mature males. The females are neoteinic and exhibit too few characters to allow determination of the genus or even the family. The best means of identifying them is by their definite association with males. In any case, the material of this sex available to us was so scanty that no attempt was made to use it for taxonomic studies of the family.

The figures were drawn with the aid of a camera lucida. Except for hooks and spines, no attempt has been made to delineate the chaetotaxy of the head or of the terminalia. Membranous areas are represented by stippling.

In the past a variety of symbols have been used by different workers for denoting various parts of the terminalia. It is only comparatively recently that Davis (1940), in his taxonomic note on the order, more or less standardised

¹ Including India proper, Pakistan and Ceylon.

the nomenclature and symbols. Ross (1940-50) has, with very slight changes, followed Davis in this respect. The terminology and symbols employed here are the same as those used by Ross (1940-50) and are listed below for ready reference :

Explanation of Symbols.

8, eighth ; 9, ninth ; 10, tenth abdominal tergites.

10L, left hemitergite of tenth tergite.

10R, right hemitergite of tenth tergite.

10LP, process of 10L.

10RP₁, major process of 10R.

10RP₂, secondary process of 10R.

H, hypandrium or ninth abdominal sternite.

HP, process of H.

LPPT and RPPT, left and right paraprocts.

LCB and RCB, left and right cercus basipodites.

LCB and LPPT, composite left cercus basipodite and left paraproct.

LC₁, basal segment of left cercus.

LC₂, terminal segment of left cercus.

RC₁, basal segment of right cercus.

RC₂, terminal segment of right cercus.

III. FAMILY OLIGOTOMIDAE.

Oligotomidae Enderlein, 1909, *Zool. Anz.* **35** : 190.

Old World Embioptera (except *Gynembia* Ross) spread by man to the New World. Males (when winged) with R_{4+5} of both wings simple, the mandibles with distinct apical dentations, 3 on the right and 2 on the left mandible ; hind basitarsi with only one bladder ; basal segment of left cercus cylindrical and non-echinulate ; major process of right hemitergite (10RP₁) long, V-shaped.

Type genus.—*Oligotoma* Westwood.

Distribution.—Warm regions of the world.

There are only two genera in the family, *Gynembia* Ross and *Oligotoma* Westwood. *Gynembia* is restricted to California and Arizona, while *Oligotoma* is more widespread. The Indian species all belong to *Oligotoma*.

IV. GENUS *Oligotoma* WESTWOOD.

Embia (*Oligotoma*) Westwood, 1837, *Trans. Linn. Soc. Lond. (Zool.)* **17** : 373, figs. (Type species : *Embia* (*Oligotoma*) *saunderisii* Westwood).

Oligotoma Westwood, Burmeister, 1839, *Handb. Ent.* **2** : 770 ; Davis, 1940, *Proc. Linn. Soc. N.S.W.* **65** : 362 ; Ross, 1940, *Ann. ent. Soc. Amer.* **33** : 667 ; 1944, *Proc. U.S. nat. Mus.* **94** : 494.

Aposthonia Krauss, 1911, *Zoologica, Stuttgart* **23** : 48 (Type species : *A. vosseleri* Krauss).

Males.—Medium to small Embioptera, the males with the following characters : winged or wingless ; if winged, with veins R_{2+3} , R_{4+5} and M simple, unforked ; R_1 joining R_{2+3} before margin. *Head* with eyes large, inflated ; mandibles elongate, the right with 3 inner apical dentations, the left with 2. *Basitarsi* of hind legs elongate with only one ventral bladder situated terminally. *Terminalia* with the tenth tergite divided submedially by a suture which is usually obsolescent anteriorly, sometimes continued to ninth tergite as a groove ; hemitergites always in contact basally ; not separated by membrane, each hemitergite bearing processes, major process of right hemitergite (10RP₁) large, generally

long, V-shaped, straight or slightly sinuous, at least four times as long as thick, near its base a smaller, medial, flap-like process ($10RP_2$), the sclerotic portion of which has the same base as $10RP_1$. $10LP$ generally long with simple or complex apex. Ninth sternite (H) large, broad basally, elongated and tapered distally in a process (HP) directed toward left cercus; $LPPT$, a sclerotic spine-like appendix terminally, is fused to the left side of HP . Left cercus basipodite (LCB) free, prominent, ring-like, often produced and specialised mesad. Left cercus two-segmented, basal segment subcylindrical to strongly clavate, occasionally lobed on inner side but never echinulate.

Females.—Too imperfectly known for analysis of possible generic characters. Hind basitarsi with only one bladder.

Distribution.—East Africa, through India and China to southern Japan, the Philippines, the East Indies, New Guinea, Australia and Tasmania, and islands in Pacific Ocean. Three species, *O. saundersii*, *O. humbertiana* and *O. nigra*, spread by man to the New World, are frequently collected and are at times commoner than the native species.

V. KEY TO THE INDIAN SPECIES OF GENUS *Oligotoma* WESTWOOD.

(Based on male specimens only).

- 1 *LCB* a complete ring with a prominent inner lobe 2
LCB an incomplete or obsolete ring without a prominent inner lobe 9
- 2 $10RP_1$ with a prominent subapical spine on outer side 3
 $10RP_1$ without a subapical spine, or, when present, it is very small and inconspicuous 5
- 3 *LCB* with the inner lobe prolonged caudad along inner side of left cercus, as a narrow caudal process; termination of $10LP$ a bifid claw directed to the left (artificially tropicopolitan) *humbertiana* (Saussure)
- LCB* with a simple broad inner lobe, without caudal process; termination of $10LP$ not as above 4
- 4 $LPPT$ complex, sclerotic, its spine with 2 arms, outer arm much smaller than the inner one; inner lobe of *LCB* broad (S. India) *falcis* Ross
- LPPT* complex, sclerotic, its spine with 2 arms, outer arm slightly longer than the inner one; inner lobe of *LCB* broader (Palkonda Hills, S. India) *pruthii* sp. n.
- 5 $10LP$ club-shaped, with 2 small separated spines on the left side subterminally; HP with many small spines (Barkuda Is., Orissa) *annandalei* sp. n.
- $10LP$ and HP not as above 6
- 6 $LPPT$ spine broad, sickle-shaped extending mesad beneath HP ; $10LP$ broad, spatulate, with curved sides, with its apex simple (artificially tropicopolitan) *saundersii* (Westwood)
- $LPPT$ spine not as above, $10LP$ narrow, acuminate or sinuous 7
- 7 $10LP$ narrow, gradually tapered distad, apex simple; $LPPT$ bulbous at base but abruptly tapered distally and with a small process anteriorly (India, Egypt, America) *nigra* Hagen
- $10LP$ broad in basal half, abruptly tapered distad, apex complex; $LPPT$ not as above 8
- 8 $10LP$ apex with an S-shaped spine directed to the left (Ceylon) *signata* sp. n.
- $10LP$ apex not as above, apex weakly bilobed with a small spine on the right (Ceylon and Calcutta, W. Bengal) *greeniana* Enderlein

- 9 *LPPT* weakly developed, indistinct 10
LPPT sclerotised and caudally terminated in the shape of a hook
which is turned outwards 13
- 10 *LC*₁ with 2 inner lobes; *10LP* short and with a small lobe on the right
(Bombay State) *asymmetrica* Menon and George
*LC*₁ without 2 lobes; *10LP* long and without a small lobe on the right 11
- 11 *10LP* dilated at apex; *HP* rather short and distinctly broad (Calcutta,
W. Bengal) *minuta* Mukerji
10LP with its apex not dilated, *HP* long and rather narrowed 12
- 12 *LC*₁ produced inwards into a strong beak (Bombay State)
. *ceylonica indica* Davis
*LC*₁ not produced inwards strongly (Ceylon, Cochin State, Orissa)
. *ceylonica ceylonica* Enderlein
- 13 *10RP*₁ and *10LP* rather long and broad, abruptly terminating in
small but distinct spines directed outwards (eastern Himalayas)
. *gravelyi* sp. n.
. 14
- 14 *10LP* long, apex narrowly rounded; *HP* with a subobtusely projection
on the right; *LPPT* terminally broad and broadly pointed (eastern
Himalayas) *montana* sp. n.
10LP rather short, apex pointed; *HP* evenly rounded without such a
projection; *LPPT* terminally narrow, acutely pointed (eastern
Himalayas) *himalayensis* sp. n.

VI. DESCRIPTIONS OF SPECIES.

1. *Oligotoma saundersii* (Westwood).

Embia (*Oligotoma*) *saundersii* Westwood, 1837, *Trans. Linn. Soc. Lond. (Zool.)* 17: 373,
pl. 2, fig. 2 (*type loc.* East India).

Oligotoma saundersii (Westwood), Burmeister, 1839, *Handb. Ent.* 2: 770; Davis, 1939,
Proc. Linn. Soc. N.S.W. 64: 181, figs. 1–4 (establishes identity); Ross, 1940, *Ann. ent.*
Soc. Amer. 33: 668, figs. 40, 42–44; 1944, *Proc. U.S. nat. Mus.* 94: 495.

Embia latreillii Rambur, 1842, *Hist. Nat. Neurop.*: 312 (*type loc.* Bombay and Madagascar).

Oligotoma latreillei (Rambur), Enderlein, 1910, *Trans. Linn. Soc. Lond. (Zool.)* (2) 14: 56;
Mukerji, 1935, *Rec. Indian Mus.* 37: 8; Menon and George, 1936, *J. Bombay Univ.*
4: 90; Davis, 1939, *Proc. Linn. Soc. N.S.W.* 64: 183.

Olyntha cubana Hagen (*nomen nudum*), 1866, *Verh. zool.-bot. Ges. Wien.* 16: 221.

Oligotoma cubana Hagen, 1885, *Canad. Ent.* 17: 141 (*type loc.* Cuba); Davis, 1939, *Proc.*
Linn. Soc. N.S.W. 64: 183 (= *O. saundersii*).

Oligotoma insularis McLachlan, 1883, *Ann. Mag. nat. Hist.* (5) 12: 227 (Hawaiian Is.);
Davis, 1939, *Proc. Linn. Soc. N.S.W.* 64: 183.

Embia bramina Saussure, 1896, *Mitt. schweiz. ent. Ges.* 9: 352 (*type loc.* Bombay).

Oligotoma bramina (Saussure), Krauss, 1911, *Zoologica, Stuttgart* 23: 37, pl. 1, fig. 6; Davis,
1939, *Proc. Linn. Soc. N.S.W.* 64: 184.

Embia hova Saussure, 1896, *Mitt. schweiz. ent. Ges.* 9: 354 (*type loc.* Madagascar).

Oligotoma hova (Saussure), Krauss, 1911, *Zoologica, Stuttgart* 23: 38.

Oligotoma rochai Navas, 1917, *Ent. Mitt.* 6: 281 (*type loc.* Brazil); Krauss, 1917, *Ent. Mitt.*
6: 316.

Oligotoma inequalis Banks, 1924, *Bull. Mus. comp. Zool. Harvard*, 65: 421 (*type loc.* West
Indies); Davis, 1939, *Proc. Linn. Soc. N.S.W.* 64: 184.

Material examined.—1 ♂ from Ceylon and 5 ♂ from India with the following
data:

CEYLON: 1 ♂, Peradeniya, 1.vi.1910 (*F. H. Gravely*).

INDIA: 1 ♂, Ratnagiri dist., ca. 400 feet, 1–2.v.1912 (*F. H. Gravely*);

1 ♂, Medha, Yenna Valley, Satara dist., ca. 2200 feet, 17–23.iv.1912 (*F. H.*

Gravelly); 1 ♂, neighbourhood of Dhupal and Gokak, Belgaum dist. (all Bombay state), -xi.1928 (*B. P. and H. S. R.*); 1 ♂ Burhampur, Madhya Pradesh, 4-6.iii.1919 (*F. H. Gravelly*) and 1 ♂, Calcutta, West Bengal, 1930.

Distribution.—East Africa, Madagascar, Ceylon, India, Malay Peninsula, Sumatra, Australia and some neighbouring islands, Formosa and southern Japan to America.

In India it has been previously recorded from South India (Ernaculum, Travancore-Cochin State); Bombay State (Ratnagiri dist., Satara dist. and Salsette Is.); Madhya Pradesh (Burhampur) and West Bengal (Calcutta). It is now recorded from Belgaum, another district of Bombay State. It is believed to be an artificially tropicopolitan species found especially near cities and towns.

Remarks.—Examples of this species have been reported by various authors under the name *O. latreillei* (Rambur) for about 30 years prior to the studies of Davis (1939), who examined the types of *O. saundersii* and *O. latreillei* and clarified their identities. Davis also observed that the name *O. saundersii* had often been applied to an entirely distinct species, namely *O. humbertiana* Saussure. Both these species are tropicopolitan and widely distributed.

O. saundersii can be easily distinguished from *O. humbertiana* as follows: the process of the left hemitergite (10LP) is short, broad and with arcuate sides, the same process in *humbertiana* being narrow, small, sinuous, with the apex abruptly hooked to the left and minutely bifurcate; the left paraproct (LPPT) bears a long, slender sickle-shaped spine extending horizontally beneath the broad apical tip of the process of the ninth sternite (HP); LPPT in *humbertiana* has a small, horizontal spine which is pointed at both ends; the distinct sub-apical spine on the outer side of the major process of the right hemitergite (10RP₁), which is present in *humbertiana*, is lacking in *O. saundersii*.

2. *Oligotoma annandalei* sp. n. (Figs. 1-5).

Holotype male (on slide).—General colour brown; head, thorax and terminalia darker; wings light brown.

Head with form as illustrated (fig. 5), slightly longer than broad; eyes large; the basal segment of antenna longer than broad; second as long as broad and the remaining segments narrow and elongate, being generally a little more than twice as long as broad. Wings with R_1 confluent with R_{2+3} , indistinct. The hyaline stripes narrow and sharply defined.

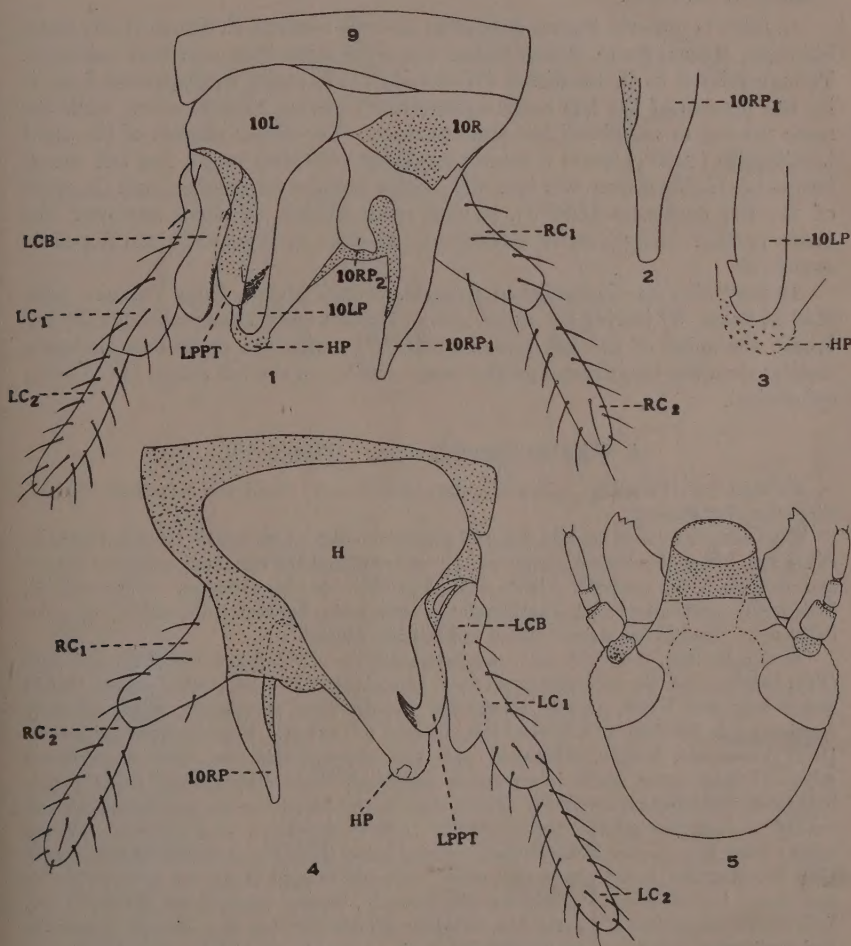
Terminalia (figs. 1-4) with the tenth tergite distinctly divided into left (10L) and right (10R) hemitergites, the suture between them being clear. Left tergal process (10LP) elongate, rather broad, slightly constricted at the base, rather club-shaped with rounded apex and bearing two well separated spines on the left side (fig. 3). Major right tergal process (10RP₁) long, directed to the left, slightly sinuous, gradually and evenly narrowed caudad to a subrounded apex with an indistinct subterminal process on the outer side, distal part slightly curved to the right. Secondary process (10RP₂) present as a small subacute triangular process. Ninth sternite (H) very distinct, broad basally but gradually narrowed towards the left cercus to a process (HP) bearing a number of short, conical spines (fig. 3). On its left side is a distinct sclerotic structure, the left paraproct (LPPT), which is broad, hooked inwards and upwards terminally and acutely pointed beneath HP. Left cercus basipodite (LCB) a distinct ring, produced mesad as a long process extending as far as 10LP or equal to about two-thirds the length of the basal segment of the left cercus (LC₁), which is broader apically and without lobes on the inner side.

Measurements (in millimetres).—Body length 9, breadth 2; fore wing length 5.6, breadth 1.3.

Holotype.—♂ (on slide), INDIA: Barkuda Is. Ganjam dist. Orissa, 21. iii. 1924 (*N. Annandale*). In the Zoological Survey of India (Reg. No. 1542/H8).

Paratypes.—Four ♂, same locality as the holotype, 3 collected on 22. iv. 1923 (*N. Annandale*) (1 on slide and 2 in alcohol) and 1 on 24. xii. 1922 (*N. Annandale*) (on slide). All in Zoological Survey of India.

Remarks.—*Oligotoma annandalei* sp. n. seems to come closest to *O. saundersii* (Westwood), from which it is easily distinguished by the process of the left hemitergite (10LP) being long and rather club-shaped, with two well separated spines on the left side of its apex, the same process in *saundersii* being short



FIGS. 1-5.—*Oligotoma annandalei* sp. n. (1) Terminalia (dorsal). (2) 10RP₁ (much enlarged). (3) 10LP and HP (much enlarged). (4) Terminalia (ventral). (5) Head.

and broad, with arcuate sides. The spine of the left paraproct (*LPPT*) in *annandalei* is broad, hooked inwards and upwards terminally and acutely pointed beneath the process of the ninth sternite (*HP*), and does not run beneath the apical tip of *HP*, as is the case in *saundersii*. The inner lobe of the left cercus basipodite (*LCB*) is also longer than that of *saundersii*, and, lastly, the process of the ninth sternite (*HP*) bears a number of short conical spines terminally which are wanting in *humbertiana*.

3. *Oligotoma falcis* Ross.

Oligotoma falcis Ross, 1943, *Psyche, Camb., Mass.* 50: 106, figs. 9-13 (*type loc.* Shimoga, Mysore, South India).

O. falcis is hitherto known only from its type locality, R. Tunga (1,865 feet), Shimoga, Mysore State, South India, where six male examples were collected. Though related to *O. saundersii* (Westwood), it is easily distinguished from it by the process of the left hemitergite (*10LP*) having parallel sides, while the same process in *saundersii* has arcuate sides. The major process of the right hemitergite (*10RP*₁) bears a more prominent subapical tooth, the left cercus basipodite (*LCB*) is narrower laterally, with a broader inner lobe; and the spine of the left paraproct (*LPPT*), though sickle-shaped, is much narrower, the outer portion being greatly developed, whereas it is scarcely developed in *saundersii*.

It may also be distinguished from *O. pruthii* sp. n., from Palkoda hills, Madras State, by having the inner lobe of the left cercus basipodite (*LCB*) less broad, the spine of the left paraproct (*LPPT*) with the outer arm distinctly smaller than the inner arm, and the basal segment of the left cercus (*LC*₁) being cylindrical.

4. *Oligotoma pruthii* sp. n. (Figs. 6-10).

Holotype male (on slide).—General colour pale brown; head and terminalia darker; wings very light brown.

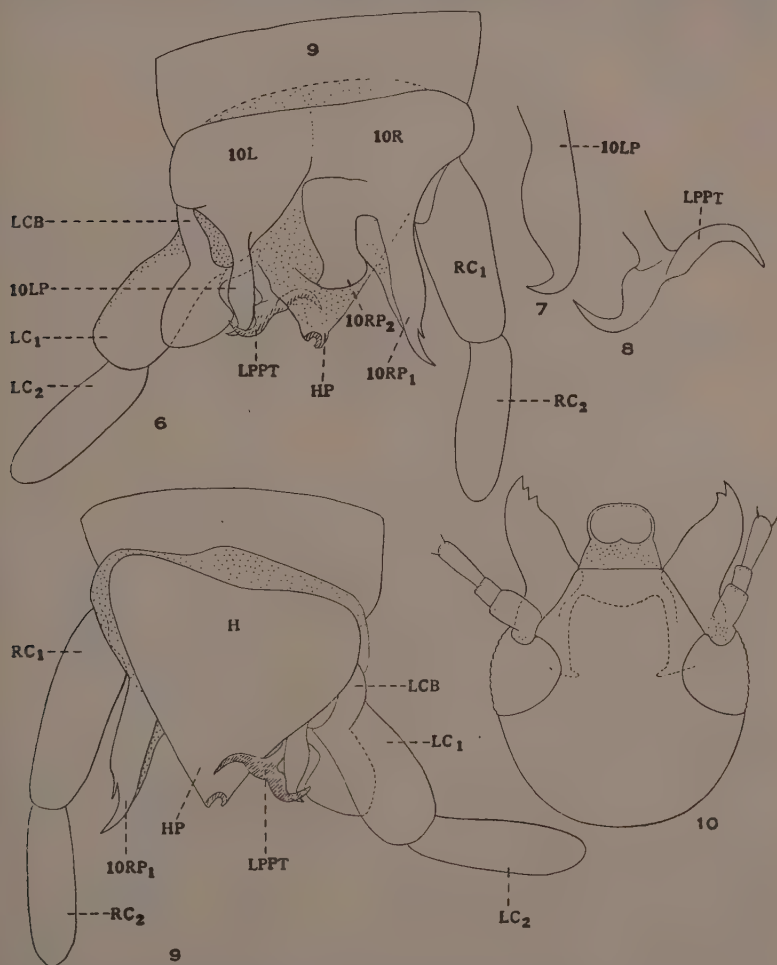
Head with form as illustrated (fig. 10), rather rounded; eyes large; the basal segment of antenna longer than broad, second as long as broad and the remaining segments narrow and elongate, being generally a little more than twice as long as broad. Wings with *R*₁ indistinctly confluent with *R*₂₊₃ subterminally, cross-veins between *C-R*₁ and *R*_{1-R}₂₊₃ also indistinct. The hyaline stripes narrow and sharply defined.

Terminalia (figs. 6-9) with tenth tergite indistinctly divided into left (*10L*) and right (*10R*) hemitergites, the suture between them being indistinct. Left tergal process (*10LP*) rather long and broad, slightly constricted basally, sides subparallel, rather abruptly terminating in the form of a broad hook, directed to the left. Major right tergal process (*10RP*₁) elongate, narrow, sclerotised apically, narrowly truncate, with a prominent subapical outer spine which is somewhat appressed. Secondary process (*10RP*₂) very indistinct, short and rather broad. Ninth sternite (*H*) broad basally, gradually narrowed caudad to a process (*HP*). Left paraproct (*LPPT*) developed as a complex, sclerotic spine; inner arm narrow, sickle-shaped, crossing below the *HP*; outer arm slightly longer than the inner one, broad proximally, turned abruptly at right angles for a short distance and thence turned abruptly at right angles laterally, tapered gradually at the distal end. Left cercus basipodite (*LCB*) ring-like, membranous laterally, but very strongly pigmented and considerably swollen on the medial side, the inner margin of which is rounded and about one-third as long as the basal segment of left cercus (*LC*₁), which is slightly broad apically and without lobes on inner side.

Measurements (in millimetres).—Body length 7.0, breadth 1.1; fore wing length 6.1, breadth 1.4.

Holotype.—♂ (on slide), INDIA : Guvvaluchervu, 500 feet, base of Palkonda hills, Vizagapatam, Madras State, at light, 1-3.viii.1929 (*H. S. Pruthi*). In the Zoological Survey of India (Reg. No. 1547/H8).

Remarks.—The species comes close to *Oligotoma falcis* Ross (1943), from R. Tungu, Shimoga, Mysore, South India, but it is easily distinguished from it by having the left cercus basipodite (*LCB*) much more broadly lobed on the medial side, and the spine of the left paraprot (*LPPT*), though as complex as that of



FIGS. 6-10.—*Oligotoma pruthii* sp. n. (6) Terminalia (dorsal). (7) 10LP (much enlarged). (8) LPPT (much enlarged). (9) Terminalia (ventral). (10) Head.

falcis, has its outer arm slightly longer than the inner arm (in the case of *falcis* the outer arm is distinctly shorter). The basal segment of the left cercus (LC_1) is also slightly broader apically than is the case in *falcis*.

5. *Oligotoma humbertiana* (Saussure).

Embia humbertiana Saussure, 1896, *Mitt. schweiz. ent. Ges.* 9 : 353 (type loc. Ceylon).

Oligotoma humbertiana (Saussure), Davis, 1939, *Proc. Linn. Soc. N.S.W.* 64 : 186, fig. 5; Ross, 1940, *Ann. ent. Soc. Amer.* 33 : 674, figs. 48-50; 1944, *Proc. U.S. nat. Mus.* 94 : 496.

Oligotoma saundersii (or *saundersi*) (Westwood), Krauss, 1911, *Zoologica, Stuttgart*, 23 : 39; Mukerji, 1935, *Rec. Indian Mus.* 37 : 8; Menon and George, 1936, *J. Bombay Univ.* 4 : 90 (all misidentifications, see Davis, 1939).

Oligotoma californica (Banks), Navas, 1923, *Rev. Acad. Ci. Zaragoza* 7 : 31 (misidentification, see Davis, 1939).

Material examined.²—Forty-eight males from various parts of INDIA, as follows :

1 ♂, Pamben, Madras State, 25.xi.1925 (*B. N. Chopra* and *H. S. Rao*) ; 1 ♂, Coimbatore, Madras State, at light, 26.ix.1913 (*T. B. Fletcher*) ; 1 ♂, forest round Chelma, 950 feet, Nallamalai Hills, Karnul dist., Madras State, 15-18.viii.1929 (*H. S. Pruthi*) ; 3 ♂, Medha, Yenna Valley, Satara dist., ca. 2200 feet, Bombay State, 23.iv.1912 (*F. H. Gravely*) ; 1 ♂, Barkuda Is., Chilka Lake, Orissa, 17.iii.1924 (*N. Annandale*) ; 1 ♂, Barkuda Is., Chilka Lake, Orissa, at light, 24.x.1923 (*N. Annandale*) ; 3 ♂, Saugor, Madhya Pradesh, at light, 19.iii.1919 (*F. H. Gravely*) ; 3 ♂, Burhampur, Madhya Pradesh, 4-6.iii.1919 (*F. H. Gravely*) ; 1 ♂, Pusa, Bihar, 22.iv.1910 (*T. B. Fletcher*) ; 1 ♂, Pusa, Bihar, 12.iii.1915 (*T. B. Fletcher*) ; 1 ♂, Pusa, Bihar, 26.ix.1913 (*T. B. Fletcher*) ; 5 ♂, Chakradharpur, Chota Nagpur, Bihar, at light, 24-26.iii.1935 (*S. L. Hora*) ; 3 ♂, Madhupur, Bihar, 28.iv.7.v.1911 (*C. Paiva*) ; 1 ♂, Calcutta, West Bengal, 10.vi.1906 (*N. Annandale*) ; 1 ♂, Calcutta, Museum Compound, 12.vii.1910 (*S. W. Kemp*) ; 1 ♂, Calcutta, 26.x.1910 (*F. H. Gravely*) ; 2 ♂, Calcutta, 3.ii.1911 (*F. H. Gravely*) ; 1 ♂, Calcutta, 7.viii.1914 (*F. H. Gravely*) ; 1 ♂, Calcutta, at light, 8.iii.1922 (*S. Riberio*) ; 2 ♂, Calcutta, at light, -.iii.1924 (*S. Riberio*) ; 2 ♂, Calcutta, at light, 28.vii.1925 (*H. S. Pruthi*) ; 1 ♂, Calcutta, at light, -.vi.1926 (*S. R.*) ; 1 ♂, Calcutta, in house, at light, 9.viii.1926 (*S. R.*) ; 1 ♂, Calcutta, at light, 21.viii.1929 (*S. R.*) ; 1 ♂, Calcutta, at light, 28.viii.1929 (*S. R.*) ; 1 ♂, Calcutta, 4.ix.1931 (*S.R.*) ; 1 ♂, Calcutta, 28.i.1935 (*S. R.*) ; 1 ♂ Calcutta, 2.ii.1935 (*S. R.*) ; 1 ♂, Calcutta, at light, 29.ix.1937 (*S. R.*) ; 1 ♂, Calcutta, (*E*) ; 3 ♂, Ross Is., Andamans, at light, 29.iii.1911 (*C. Paiva*).

Distribution.—*O. humbertiana* is an artificially tropicopolitan species spread by transport throughout the warm regions of the world. It is widely spread from East Africa, Seychelles, Ceylon, India, Andaman Is., Malay Peninsula, Java, Philippine Islands, Formosa, China and Japan to America.

In India it has previously been recorded from South India (Cochin State and Malabar coast), Bombay State (Satara dist. and Salsette Is.), Madhya Pradesh (Saugor and Burhampur), Orissa (Barkuda Is., Chilka Lake), West Bengal (Calcutta) and Andaman Is. It is now being recorded from Pamben, Coimbatore

² The material examined includes the whole series of specimens identified as *O. saundersii* (Westwood) by Mukerji (1935), except one male from Ratnagiri dist., Bombay State, which remains identified as *O. saundersii*.

and Nallamalai hills in Madras State and Pusa, Chakradharpur and Madhupur in Bihar.

Remarks.—Being a very widely distributed and easily collected species, *O. humbertiana* has frequently been fully described and illustrated under the name *O. saundersii* (Westwood).

O. humbertiana is easily distinguished from *O. saundersii* by the process of the left hemitergite (10LP) being small, very narrow, sinuous, its apex abruptly hooked to the left and minutely bifurcate; the same process in *saundersii* is short, broad and with arcuate sides. The spine of the left paraproct (LPPT), which is small, horizontal and pointed at both ends in *humbertiana*, is long, slender, sickle-shaped, running beneath the broad apical tip of the process of the ninth sternite (HP) in *saundersii*. The distinct subapical spine on the outer side of the major process of the right hemitergite (10RP₁), which is present in *humbertiana*, is absent in *saundersii*. Lastly the inner lobe of the left cercus basipodite (LCB) has a caudal process in *humbertiana* which is absent in *saundersii*.

6. *Oligotoma nigra* Hagen.

Embia nigra Hagen (*nomen nudum*), 1866, *Verh. zool-bot. Ges. Wien* 16 : 221.

Oligotoma nigra Hagen, 1885, *Canad. Ent.* 17 : 174 (type loc. Egypt); Davis, 1939, *Proc.*

Linn. Soc. N.S.W. 64 : 188; 1940, *ibid.* 65 : 363, fig. 1; Ross, 1940, *Ann. ent. Soc. Amer.* 33 : 670, figs. 3, 41, 45–47; 1944, *Proc. U.S. nat. Mus.* 94 : 495.

Embia californica Banks, 1906, *Trans. Amer. ent. Soc.* 32 : 1, pl. 1, fig. 1 (type loc. California); Davis, 1940, *Proc. Linn. Soc. N.S.W.* 65 : 364; Ross, 1940, *Ann. ent. Soc. Amer.* 33 : 673.

Oligotoma californica (Banks), Banks, 1924, *Bull. Mus. comp. Zool.* 65 : 421, fig. (in part).

Oligotoma saundersii (Westwood), Needham, 1909, *Rec. Indian Mus.* 3 : 193, fig. 11 (misidentification, see Ross, 1940).

Oligotoma mesopotamica Esben-Petersen, 1929, *Ent. mon. Mag.* (3) 15 : 8, fig. (type loc. Baghdad); Davis, 1939, *Proc. Linn. Soc. N.S.W.* 64 : 188 (= *O. nigra*); 1940, *ibid.* 65 : 364.

Material examined.—Three males from Pakistan and 1 from India as follows :

PAKISTAN : 1 ♂, Taru, Peshawar dist., N.W.F.P., 16–29.v.1915 (*T. B. Fletcher*); 1 ♂, Tarab, Peshawar dist., N.W.F.P., 2.v–vi.1916 (*T. B. Fletcher*); 1 ♂, Uchhali, ca. 2800 feet, Salt Range, West Punjab, 18.iv.1931 (*H. S. Pruthi*).

INDIA : 1 ♂, Almora, 5500 feet Kumaon, Uttar Pradesh, 1–18.iv.1912 (*C. C. Paiva*).

Distribution.—*O. nigra* has been recorded from the date-growing regions of the Old and New World, from Egypt, Palestine, Irak, India and south-western United States of America.

Its occurrence in India was previously known only from a single male from Amballa in East Punjab, identified as *Oligotoma michaeli* McLachlan by Hagen (1885 : 154) and subsequently identified as *O. nigra* by Davis (1940). It is now being recorded from Peshawar (N.W.F.P., Pakistan), Salt Range (Punjab, Pakistan) and Almora (Kumaon hills, Uttar Pradesh, India). The present record not only narrows the gap in its distribution between India and Iraq but also shows that it is more widely distributed and also occurs eastwards of Amballa (Punjab, India).

Remarks.—The specimen from Almora (5500 feet) has been very carefully compared with the published descriptions and figures and with the material from Salt Range and Peshawar, and we believe that, although the species has never previously been taken at this altitude, there is no doubt about its identity.

O. nigra is easily distinguished from *O. saundersii* (Westwood) and *O. humbertiana* (Saussure), the other two widely distributed species, by the spine of the left paraproct (*LPPT*) being stout and bulbous at the base but abruptly tapered and hooked distally and with a small process anteriorly. The same spine is long, slender, sickle-shaped, extending beneath the broad apical tip of the process of the ninth sternite (*HP*) in *saundersii*, but it is small and pointed at both ends in *humbertiana*.

7. *Oligotoma greeniana* Enderlein.

Oligotoma greeniana Enderlein, 1912, *Coll. Zool. Selys-Longchamps* 3 : 83, fig. 55 (type loc. Peradeniya, Ceylon); Friederichs, 1923, *Capitata Zool.* 2 : 6; Davis, 1940, *Proc. Linn. Soc. N.S.W.* 65 : 365, figs. 2-11.

Material examined.—Four males from Ceylon and 1 male from India, as follows :

CEYLON : 1 ♂, Peradeniya, -vi.1910 (*F. H. Gravely*) : 1 ♂, Peradeniya, -viii.1910 (*F. H. Gravely*) : 2 ♂, Peradeniya, 9.vi.1910 (*F. H. Gravely*).

INDIA : 1 ♂, Calcutta, West Bengal, at light, 4.xii.1928 (*H. S. Pruthi*).

Distribution.—Previously known only from Ceylon, the species is now recorded from India at Calcutta in West Bengal.

Remarks.—*O. greeniana* seems to come closest to *O. signata* sp. n. from Ceylon, from which it is easily distinguished by the process of the left hemitergite (*10LP*) being long, broad in the basal half, abruptly tapered to a complex tip, which is weakly bilobed and with a small spine on the right; the same process in *signata* has a complex tip with an S-shaped hook terminally. The major process of the right hemitergite (*10RP₁*) in *greeniana* has a terminal dorsal hook which is wanting in *signata*.

O. greeniana may also be distinguished from *O. nigra* Hagen, which has the process of the left hemitergite (*10LP*) small, very slender and with a simple tip. The major process of the right hemitergite (*10RP₁*) in *greeniana* is long, V-shaped, the apex with a terminal dorsal hook and a ventral flange on the left; the same process in *nigra* is long, V-shaped, with a simple apex. The spine of the left paraproct (*LPPT*), an acute process in *greeniana*, is stout and bulbous at the base but abruptly tapered and hooked distally and with a process anteriorly in *nigra*.

8. *Oligotoma signata* sp. n. (Figs. 11-15).

Holotype male (on slide).—General colour brown, head and terminalia darker, wings lighter.

Head with form as illustrated (fig. 15), slightly longer than broad; eyes large; the basal segment of antenna longer than broad, second nearly as long as broad and succeeding segments narrow and elongate, being generally two and a half times as long as broad. Wings with *R₁* confluent with *R₂₊₃* subterminally, cross-veins between *C-R₁* and *R₁-R₂₊₃* indistinct. The hyaline stripes narrow and distinct.

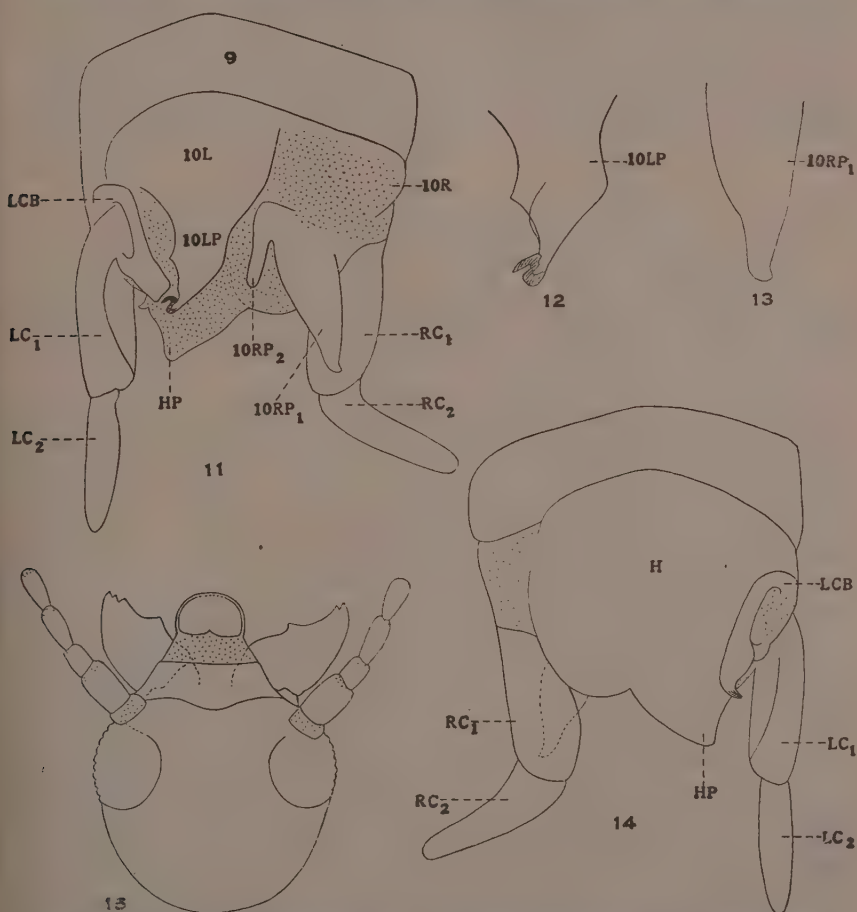
Terminalia (figs. 11-14) with the tenth tergite distinctly divided into left (*10L*) and right (*10R*) hemitergites, the suture between them being very clear. Left tergal process (*10LP*) long, broad in basal half, thence terminating rather abruptly to a complex apex with S-shaped, heavily chitinised hook directed towards left side. Major right tergal process (*10RP₁*) long, with arcuate sides, gradually terminating caudad to a simple obtuse apex. Secondary process (*10RP₂*) present as a distinct long and narrow process. Ninth sternite

(H) quite distinct, broad basally but gradually narrowed to a process (HP). Left paraproot (LPPT) developed as a weakly chitinated structure, terminating in an acute process directed outwards, the whole structure fused to the left-hand margin of HP. Left cercus basipodite (LCB) free, ring-like, produced mesad as a broad, simple subrounded lobe. Basal segment of left cercus (LC_1) cylindrical without lobes on the inner side.

Measurements (in millimetres).—Body length 6.5, breadth 0.8; fore wing length 5.1, breadth 1.1.

Holotype.—♂ (on slide), CEYLON: Peradeniya: -vii.1910. In the Zoological Survey of India (Reg. No. 1548/H8).

Remarks.—*O. signata* sp. n. is closely related to *O. greeniana* Enderlein from Ceylon and India, but is distinguished from it by the process of the left hemitergite (10LP) having an S-shaped hook terminally; the same process in *greeniana* has a complex tip which is weakly bilobed with a small spine on the



FIGS. 11-15.—*Oligotoma signata* sp. n. (11) Terminalia (dorsal). (12) 10LP (much enlarged). (13) 10RP₁ (much enlarged). (14) Terminalia (ventral). (15) Head.

right. In addition the major process of the right hemitergite (10RP₁) is simple, without the terminal, dorsal hook which is present in *greeniana*.

9. *Oligotoma michaeli* McLachlan (?).

Oligotoma michaeli McLachlan, 1877, *J. Linn. Soc. (Zool.)* 13 : 383 (type loc. ? India) ; Mukerji, 1935, *Rec. Indian Mus.* 37 : 7, fig. 3 ; Davis, 1940, *Proc. Linn. Soc. N.S.W.* 65 : 368, figs. 20-21.

Material examined.—One male (terminalia on slide), from INDIA : Shillong, ca. 4900 feet, Assam, 30.v.1918 (*A. G. R. Coll.*)

Remarks.—The identity of *O. michaeli*, as already noted by Davis (1940), remains unknown, because McLachlan's type lacks terminalia and his remarks concerning them would fit many known species of *Oligotoma*. According to Davis (1940 : 368), the example named by Mukerji (1935) as *O. michaeli* is a distinct species. The terminalia mounted on the slide of this specimen are in the collection of the Zoological Survey of India, but unfortunately the remaining parts, except four legs, are neither mounted on the slide nor traceable in the collection. The terminalia do not resemble those of any known species of *Oligotoma* and, as the specimen is imperfect, it seems pointless to describe it.

10. *Oligotoma minuta* Mukerji. (Figs. 16-20).

Oligotoma minuta Mukerji, 1935, *Rec. Indian Mus.* 37 : 1, fig. 1 (a-c) (type loc. Calcutta).

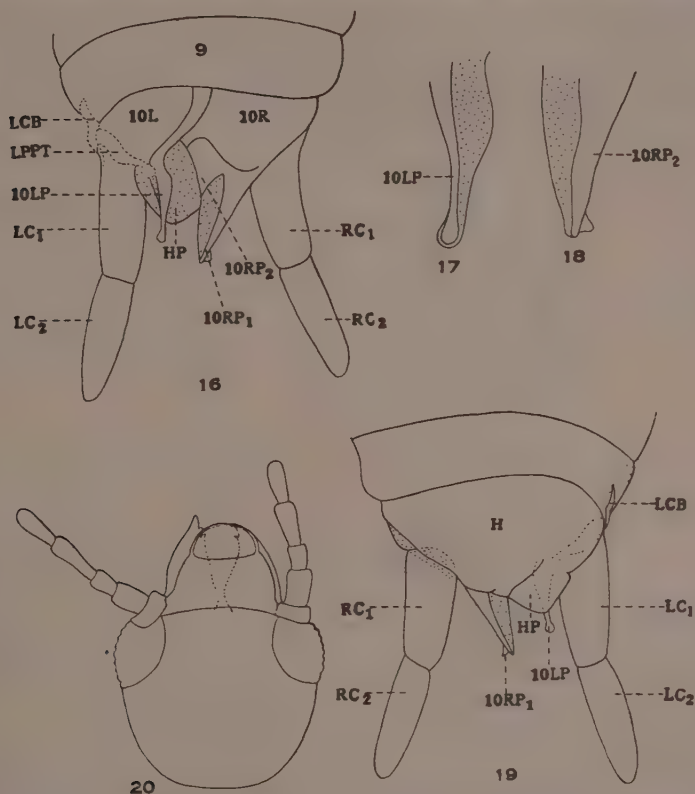
Mukerji described *O. minuta* from four male specimens which he said were "presumably collected from Calcutta and its suburbs as follows:—C. Paiva Coll. : 15.iv.14 in house ; F. H. Gravely Coll. : 21.v.11, Zoological Garden, Alipur ; F. H. Gravely Coll. : 19.v.15, in house at light ; F. H. Gravely Coll. 25.ix.16."

In 1940 Davis stated that *O. minuta* was not specifically distinct and appeared to be a small form of *Oligotoma ceylonica ceylonica* Enderlein (1912). Davis, however, did not examine the type or any example of *O. minuta* and apparently based his opinion on the description given by Mukerji. The type material of *O. minuta*, which was stated to have been deposited in the Indian Museum, is believed to have been lost in the Varuna floods of 1943 at Benares, where the collections were evacuated during the war, but the unnamed material of Embioptera in the Indian Museum includes one example which agrees with the description of *O. minuta* and bears the following locality label "Zool. Garden, Alipur, Calcutta, 21.v.1911. F. H. Gravely". It will be noted that one of the examples from the type material mentioned by Mukerji bears the same particulars and it is probable that this specimen is the same as that referred to by Mukerji. Moreover, as is obvious from the method of study described by him, he did not make any slide preparations of this material. However, as the specimen does not bear any identification label it is being designated as neotype. Although Mukerji gave a long description of *O. minuta*, it must be pointed out that he did not adequately describe the terminalia, especially the processes of the left and right hemitergites. He merely stated that "the form of the chitinous process of Xth tergite together with the size of the insect at once distinguish the species". Perhaps this is what led Davis to consider it to be a small form of *O. ceylonica ceylonica*, to which it bears a fairly close resemblance. However, in the details of its structure it is very distinct from

the latter and is here considered to be a valid species. It is being redescribed below.

Neotype male (on slide).—General colour very pale brown, head and terminalia darker, wings more or less hyaline.

Head with form as illustrated (fig. 20), rather oval; eyes reniform; the basal segment of antenna twice as broad as long, second longer than broad, third nearly as long as broad



FIGS. 16–20.—*Oligotoma minuta* Mukerji. (16) Terminalia (dorsal). (17) 10LP (much enlarged). (18) 10RP₁ (much enlarged). (19) Terminalia (ventral). (20) Head.

and the succeeding segments long and narrow, being generally two and half times as long as broad. Wings with R_1 very distinctly confluent with R_{2+3} subterminally, cross-veins between $C-R_1$ and R_1-R_{2+3} indistinct. The hyaline stripes broad and indistinctly defined.

Terminalia (figs. 16–19) with tenth tergite distinctly divided into left (10L) and right (10R) hemitergites, the suture between them distinct; 10R larger than 10L. Left tergal process (10LP) elongate, slightly constricted basally, sides of basal two-thirds arcuate, almost membranous and pigmented, the process terminating in a rather small expanded lobe. Major right tergal process (10RP₁) long, concave inwardly, gradually narrowed caudad, with a small but distinct subterminal outer process. Secondary process (10RP₂) represented by a very weakly chitinised, indistinct and rather triangular process. Ninth

sternite (*H*) quite distinct, broad basally, gradually narrowed caudad to a broad and rather triangular process (*HP*), which reaches about two-thirds the length of *10LP*. Left paraproct (*LPPT*) very weakly developed and fused to the ninth sternite (*H*). Left cercus basipodite (*LCB*), indistinct. Cerci more or less similar in shape; basal segment of left cercus (*LC*₁) cylindrical and without lobes on the inner side.

Measurements (in millimetres).—Body length 4.2, breadth 0.2; fore wing length 2.5, breadth 0.2.

Neotype.—♂ (on slide), INDIA: Zool. Garden, Alipore, Calcutta; 21.v.1911 (*F. H. Gravely*). In the Zoological Survey of India (Reg. No. 1549/H8).

Remarks.—*Oligotoma minuta* may be distinguished from *O. ceylonica* *ceylonica* Enderlein by the characters given in the following table:

	<i>minuta</i> .	<i>ceylonica</i> .
Length.	4.2 mm.	5.5-6.5 mm.
<i>10LP</i>	Elongate but slightly constricted basally, sides of basal two-thirds arcuate, the process terminating into a rather small expanded lobe	Elongate, evenly narrowed to a simple rounded apex.
<i>H</i>	Produced back to a broad and rather triangular process <i>HP</i> , reaching about two-thirds the length of <i>10LP</i>	Produced back to an obtuse process <i>HP</i> , reaching as far as <i>10LP</i> .
<i>LC</i> ₁	Equals <i>LC</i> ₂	Longer than <i>LC</i> ₂ .
<i>LPPT</i>	Very weakly developed and indistinct	Weakly developed but distinct.

11. *Oligotoma ceylonica* Enderlein.

Oligotoma ceylonica Enderlein, 1912, *Coll. Zool. Selys Longchamps* 3: 83, fig. 56 (*type loc.* Peradeniya, Ceylon).

This species has two subspecies, both of which occur in the area studied.

11a. *Oligotoma ceylonica ceylonica* Enderlein.

Oligotoma ceylonica ceylonica Enderlein, Davis, 1940, *Proc. Linn. Soc. N.S.W.* 65: 378, figs. 51-61.

Oligotoma ceylonica var. *variegata* Mukerji, 1935, *Rec. Indian Mus.* 37: 4, figs. 2, a-k (*type loc.* Ceylon and Barkuda Is.); Davis, 1940, *Proc. Linn. Soc. N.S.W.* 65: 378, fig. (= *O. ceylonica ceylonica*).

Enderlein described *O. ceylonica* from males collected at Peradeniya, Ceylon. In 1935 Mukerji described the variety *variegata* from Peradeniya, Ceylon; and Barkuda Is., Orissa, India, but Davis (1940) considered it to be a synonym of *O. ceylonica ceylonica*, thus extending its distribution from Ceylon to India (eastern coast). In 1940 Davis described a subspecies *O. ceylonica indica* from Bombay and Cochin, which necessitated referring to the nominotypical form as *O. ceylonica ceylonica*. It belongs to the group of species with the left cercus basipodite (*LCB*) inconspicuous and weakly developed. From *O. ceylonica indica* it is distinguished by the basal segment of the left cercus (*LC*₁) not being produced inwards into a beak-like process; the segment in *indica* is produced markedly into a beak.

The characters distinguishing it from *O. minuta* have already been enumerated under that species.

11b. *Oligotoma ceylonica indica* Davis.

Oligotoma ceylonica indica, Davis, 1940, *Proc. Linn. Soc. N.S.W.* 65 : 380, figs. 62–66 (type loc. Santa Cruz, Salsette Is., Bombay).

Davis described *O. ceylonica indica* from males collected at Santa Cruz, Salsette Is., Bombay and Ernakulum, Cochin, and previously identified as *O. ceylonica* var. *variegata* Mukerji by Menon and George (1936). The six male specimens from Bombay, designated as types, are clearly distinct from *O. ceylonica ceylonica* Enderlein, and can be easily distinguished from it by the beak-like prolongation of the internal margin of the basal segment of the left cercus (LC_1). The specimens from Cochin are no doubt intermediate between the two subspecies, as they have the basal segment of the left cercus less markedly beaked.

The species *O. ceylonica* is apparently very variable and more intensive collecting will throw light on its taxonomy. As it is, it shows considerable variation along the west coast of India, so much so as to be subspecifically distinct, while along the east coast it seems to remain practically unchanged.

12. *Oligotoma asymmetrica* Menon and George.

Oligotoma asymmetrica Menon and George, 1936, *J. Bombay Univ.* 4 : 92, pl. iii, fig. 1 (type loc. Santa Cruz, Salsette Is., Bombay); Davis, 1940, *Proc. Linn. Soc. N.S.W.* 65 : 381, fig. 73.

O. asymmetrica is known from one male example (type), collected from Santa Cruz, Salsette Is., Bombay. It is easily distinguished from other species of *Oligotoma* by the basal segment of its left cercus (LC_1) having two lobes, the basal lobe being short and the subterminal lobe long, slender and curved forwards. It is also characterised by the process of the left hemitergite (10LP) being short, obtuse and with a small lobe on the right. The figures given by Menon and George do not show the details of the left paraproct (LPPT), which is probably inconspicuous. It is therefore probably closely related to *O. ceylonica ceylonica* Enderlein, which has the basal segment (LC_1) of the left cercus without two lobes on the inner side and the process of the left hemitergite (10LP) elongate, evenly narrowed to a simple rounded apex.

13. *Oligotoma gravelyi* sp. n. (Figs. 21–30).

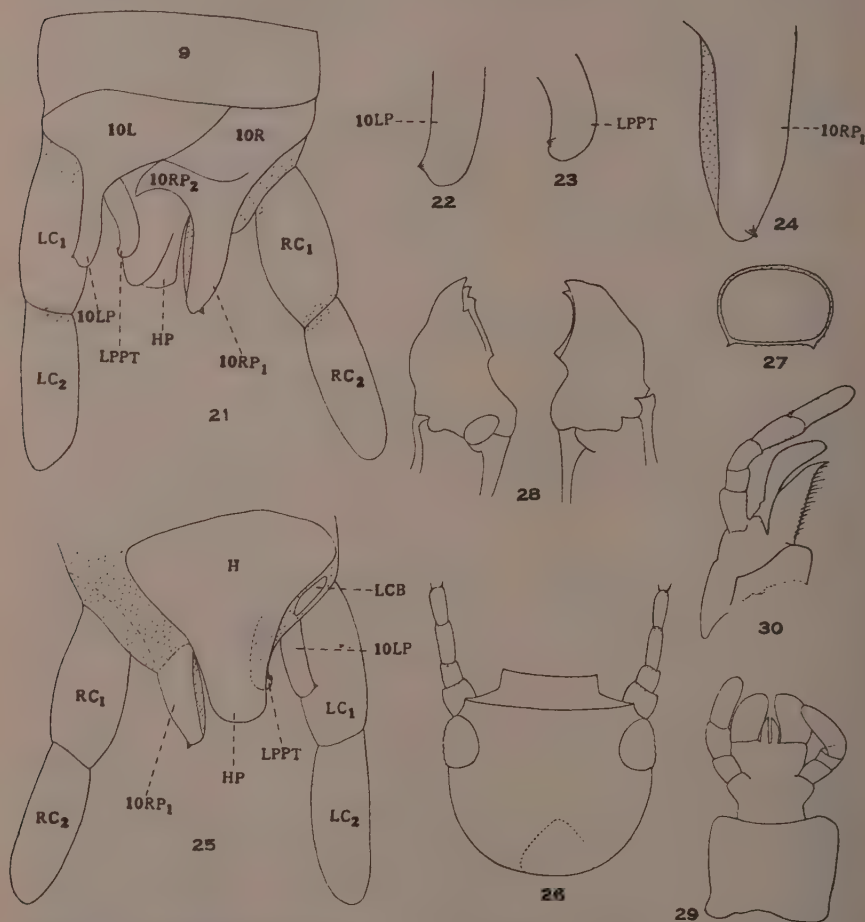
Holotype male (on slide).—General colour brown; head; thorax and terminalia darker; wings brown.

Head with form as illustrated (fig. 26), longer than broad, eyes rather small; basal segment of antenna short and broad, the second longer than broad, the third as long as broad and the succeeding segments long and narrow, being generally two and a half times as long as broad. Wings with R_1 confluent with R_{2+3} subterminally and 4 weak cross-veins between $C-R_1$ and 3 between R_1-R_{2+3} . The hyaline stripes narrow and sharply defined.

Terminalia (figs. 21–25) with the tenth tergite indistinctly divided into left (10L) and right (10R) hemitergites. Left tergal process (10LP) elongate, broad, slightly constricted at the base, terminating in a rounded apex with a small, thickly chitinated spine on its left

side. Major right tergal process ($10RP_1$) long and broad, sides more or less parallel for about two-thirds of the length, after which they are gradually narrowed caudad to an obtusely pointed apex which has one small, thickly chitinised spine on its right side sub-apically. Secondary process ($10RP_2$) very indistinct. Ninth sternite (H) also indistinct, broad basally but narrowed towards left cercus to a broad process (HP). Left paraproct ($LPPT$) broad, sclerotic, hooked outwards and upwards terminally and bearing a small, thickly chitinised spine subterminally on the outer side. Left cercus basipodite (LCB) represented by an indistinct piece at the outer base of left cercus. Basal segment of left cercus (LC_1) rather broad apically and without lobes on inner side.

Measurements (in millimetres).—Body length 15, breadth 2.5; fore wing length 9, breadth 2.5.



FIGS. 21-30.—*Oligotoma graveleyi* sp. n. (21) Terminalia (dorsal). (22) $10LP$ (much enlarged). (23) $LPPT$ (much enlarged). (24) $10RP_1$ (much enlarged). (25) Terminalia (ventral). (26) Head. (27) Labrum. (28) Mandibles. (29) Labium. (30) Maxilla.

Holotype.—♂ (on slide), INDIA : Kalimpong, Darjeeling dist., 24.iv.–10.v.1915 (*F. H. Gravely*). In the Zoological Survey of India (Reg. No. No. 1550/H8).

Paratype.—♂ (on slide), same data as the holotype ; also deposited in the Zoological Survey of India.

Remarks.—*O. gravelyi* sp. n. comes closest to *montana* and *himalayensis* sp. n., all of which have the left cercus basipodite (*LCB*) incomplete and obsolete, the left paraproct (*LPPT*) sclerotised, terminally in the shape of a hook that is turned outwards and upwards and is acutely or broadly pointed. However, it is easily distinguished from these species by the characteristic spines of the left tergal process (*10LP*) and major right tergal process (*10RP*₁), which are absent in *montana* and *himalayensis*.

14. *Oligotoma montana* sp. n. (Figs. 31–35).

Holotype male (on slide).—General colour brown ; head and terminalia darker ; wings lighter.

Head with form as illustrated (fig. 35), distinctly longer than broad ; eyes rather small ; the basal segment of antenna short and broad, the second longer than broad, the third nearly as broad as long, and the succeeding segments elongate and narrow, being generally two and a half times as long as broad. Wings with *R*₁ confluent with *R*₂₊₃ subterminally, 3 cross veins between *C*–*R*₁ and 4 between *R*₁–*R*₂₊₃ quite distinct. The hyaline stripes narrow and distinct.

Terminalia (figs. 31–34) with the tenth tergite indistinctly divided into left (*10L*) and right (*10R*) hemitergites, the suture between them being obsolete anteriorly. Left tergal process (*10LP*) elongate, slender, rather constricted basally and rounded terminally. Major right tergal process (*10RP*₁) elongate, gradually and evenly narrowed caudad, and with the apex simple, subtended by a small subterminal outer process. Secondary process (*10RP*₂) small and triangular. Ninth sternite (*H*) very indistinct, but obviously broad basally, narrowed caudally to a rather obtuse process (*HP*) with a subobtuse projection near right terminal angle. Left paraproct (*LPPT*) broad, sclerotic, terminally in the shape of a hook that is turned outwards and upwards and is broadly pointed. Left cercus basipodite (*LCB*) represented only by a chitinised piece at the outer base of left cercus. Basal segment of left cercus (*RC*₁) slightly dilated on the inner side apically.

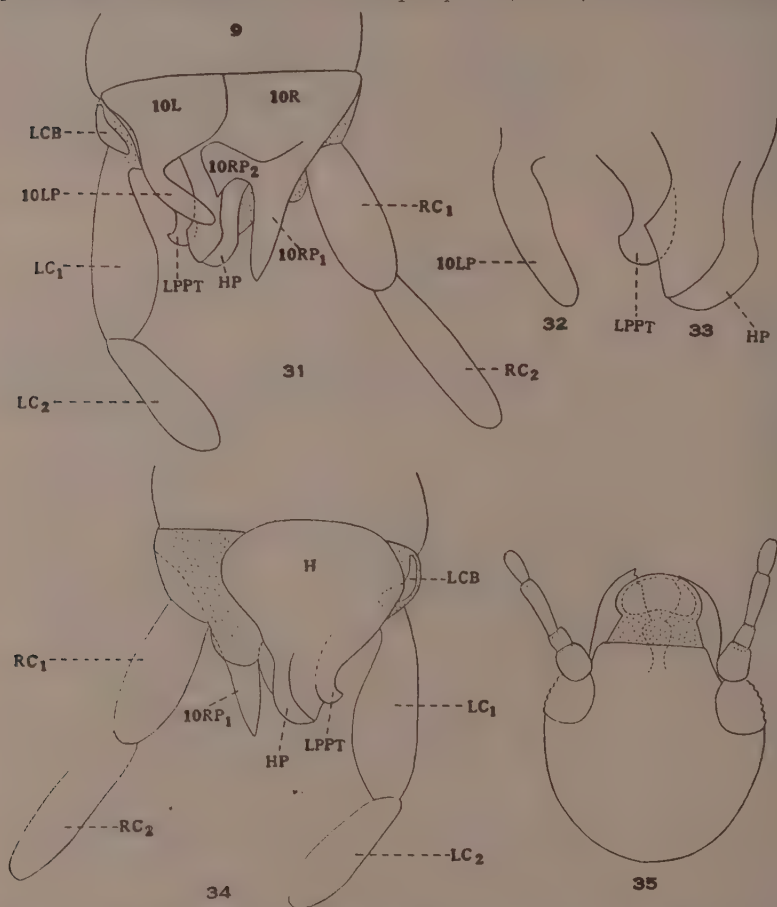
Measurements (in millimetres).—Body length 14, breadth 2 ; fore wing length 9, breadth 2.5.

Holotype.—♂ (on slide), INDIA : Pashok (ca. 4000 feet) Darjeeling dist., eastern Himalayas, 26.v.–14.vi.1916 (*F. H. Gravely*). In the Zoological Survey of India (Reg. No. 1552/H8).

Paratypes.—♂ (on slide), same data as the holotype ; also in the Zoological Survey of India.

Remarks.—According to the key given by Davis (1940 : 385) *O. montana* sp. n. comes closer to *O. varians* Navas (China), but is easily separated from the latter by the process of its left hemitergite (*10LP*) being longer and narrower ; the same process is not obtusely angulate on the inner margin and its apex is not curved outwards as is the case in *variens*. The process of the ninth sternite (*HP*), which in *montana* is obtusely tapered with a subobtuse projection on its right apical angle, is subevenly rounded without any projection in *variens*. Finally, the basal segment of the cercus (*LC*₁), which is scarcely dilated apically in *variens*, is slightly dilated in *montana*.

Among the Indian species *O. montana* comes closest to *O. himalayensis* sp. n. However, it is easily distinguished by the process of the left hemitergite (10LP) being elongate, slender and rounded terminally; this process in *himalayensis* is rather short and abruptly terminated caudally to a narrow process. The termination of the left paraproct (LPPT), which is subacutely



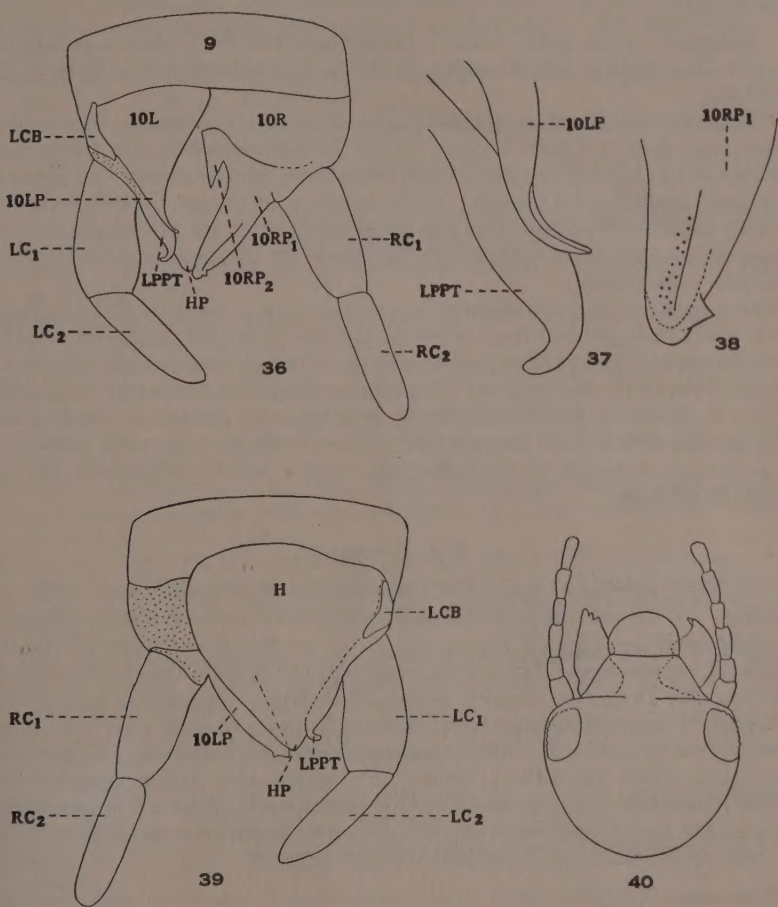
FIGS. 31-35.—*Oligotoma montana* sp. n. (31) Terminalia (dorsal). (32) 10LP (much enlarged). (33) HP (much enlarged). (34) Terminalia (ventral). (35) Head.

pointed in *himalayensis*, is distinctly broad in *montana*. The process of the ninth sternite (HP) differs from that of *himalayensis* in the same way as it does from *varians*.

15. *Oligotoma himalayensis* sp. n. (Figs. 36-40).

Holotype male (on slide).—General colour light brown, head and terminalia darker, wings paler.

Head with form as illustrated (fig. 40), slightly longer than broad, eyes large, the basal segment of antenna longer than broad, the second nearly as long as broad, and the succeeding segments long and narrow, being generally a little more than twice as long as broad. Wings with R_1 confluent with R_{2+3} subterminally, cross-veins between $C-R_1$ and R_1-R_{2+3} indistinct. The hyaline stripes narrow and sharply defined.



FIGS. 36-40.—*Oligotoma himalayensis* sp. n. (36) Terminalia (dorsal). (37) 10LP and LPPT (much enlarged). (38) 10RP₁ (much enlarged). (39) Terminalia (ventral). (40) Head.

Terminalia (figs. 36-39) with the tenth tergite distinctly divided into left (10L) and right (10R) hemitergites; the inner margin of 10L is distinct. Left tergal process (10LP) rather short and abruptly tapered caudally to a narrow process which is directed inwards. Major right tergal process (10RP₁) long, gradually tapered to a narrowly rounded apex, subterminally with a very small but distinct outer process (10RP₂). Secondary process small and subtriangular. Ninth sternite (H) distinct, broad basally, but gradually narrowed to a process (HP) which is simple and rather rounded. Left paraproct (LPPT) narrow,

sclerotic, terminally in the shape of a hook that is turned outwards and upwards and is subacutely pointed. Left cercus basipodite (LCB) represented only by a chitinised, triangular plate at the outer base of the left cercus. Basal segment of left cercus (LC₁) near cylindrical, slightly broader apically and without lobes on the inner side.

Measurements (in millimetres).—Body length 6.5, breadth 0.5; fore wing length 5, breadth 1.1.

Holotype.—♂ (on slide), INDIA: Darjeeling (7000 feet), eastern Himalayas, 28.iv.-14.v.1915 (F. H. Gravely). In the Zoological Survey of India (Reg. No. 1554/H8).

Remarks.—*O. himalayensis* is closely related to *O. borneensis* Hagen (from South-east Asia and East Indies), but is distinguished from the latter in its process of the left hemitergite (10LP) being considerably shorter and abruptly narrowed caudally to a process; the termination of the left paraproct (LPPT) is also subacutely pointed and the basal segment of the left cercus (LC₁) is more or less cylindrical without any dilatation on the inner side, which is not the case in *borneensis*.

O. himalayensis comes close to *O. montana* sp. n. among the Indian species. It is easily distinguished from it by the process of the left hemitergite (10LP) being short and abruptly narrowed caudally; this process is long, slender and rounded terminally in *montana*. The termination of the left paraproct (LPPT), which is distinctly broad in *montana*, is subacutely pointed in *himalayensis*. The process of the ninth sternite (HP), which is simple and rather rounded in *himalayensis*, is rather obtuse terminally, with a subobtuse projection on the right, in *montana*.

VII. SUMMARY.

Hitherto only eight species of Oligotomidae were known from India and Ceylon. In the present paper six new species are described, namely *Oligotoma annandalei* from Barkuda Island, Orissa, *O. pruthii* from Palkonda Hills, S. India, *O. signata* from Ceylon, and *O. gravelyi*, *O. montana* and *O. himalayensis*, all from the Darjeeling district, eastern Himalayas. It has also been pointed out that *O. minuta* Mukerji, from Calcutta, appears to be a good species and should not be confused with *O. ceylonica ceylonica* Enderlein. *O. greeniana* Enderlein, which was hitherto known only from Ceylon, is now recorded from India (Calcutta). Several new distributional records of certain known Indian species are also given, based on the extensive material now available. A key to the species occurring in the Indian region is given.

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